

Lessons Learned from the NASA Plum Brook Reactor Facility Decommissioning

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INTRODUCTION

NASA has been conducting decommissioning activities at its PBRF for the last decade. As a result of all this work there have been several ‘lessons learned’, both good and bad. This paper presents some of the more exportable lessons.

PBRF BACKGROUND

The National Aeronautics and Space Administration (NASA) Plum Brook Reactor Facility (PBRF) is located in Sandusky, Ohio, approximately 50 miles west of the NASA Glenn Research Center in Cleveland. It was used to expose test materials to a high neutron flux, and then to perform the post-exposure testing to determine any changes in properties. This testing was performed in support of the NERVA and ROVER nuclear rocket programs.

The main reactor was a 60 MW pressurized water reactor. It had numerous ports and tubes for inserting test specimens. There were also several fast neutron beam tubes and a large tube that provided a thermalized neutron beam. It had one test loop that ran at liquid helium temperatures, with capability to perform in-core tensile testing or fatigue testing of material specimens to failure. Fig. 1 shows a cutaway section of the main reactor.

A series of seven hot cells (the largest rated for 1.5 million curies) was connected to the reactors by means of a 25’ deep water filled canal system. Irradiated experiments could safely be transferred by means of a remote operated monorail on the bottom of the canal, and associated cranes.

Construction began in 1958. The plant was operated from 1961 to 1973, accumulating a total of 98,000 MW hours of operation. With the end of Apollo and the termination of the nuclear rocket program the decision was made to shut down PBRF. It was placed in Safe Dry Storage. Fig. 2 shows the PBRF during this shutdown period.

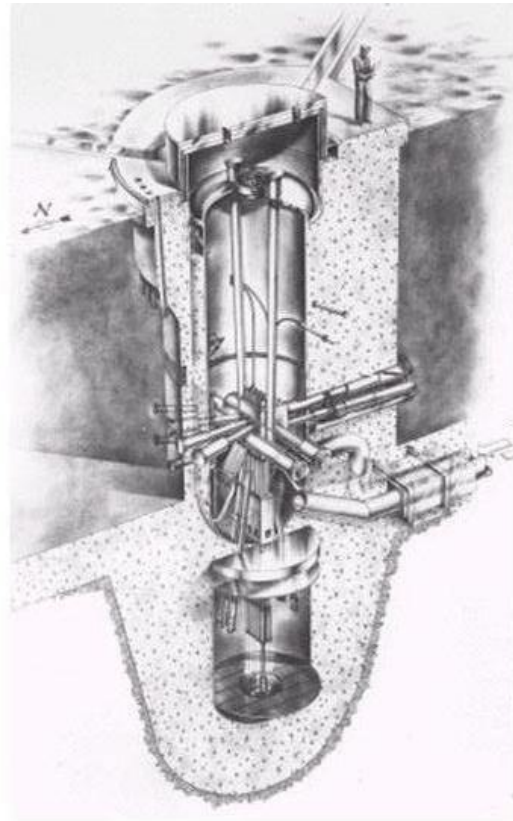


Fig. 1. Cutaway view of the main reactor



Fig. 2. View of the PBRF circa 1995

In 1999 NASA began predecommissioning, and full decommissioning began in 2002 with the NRC approval of the Decommissioning Plan (D-Plan). NASA expects to finish field work in 2010, then to request license termination after Final Status Survey (FSS) completion in 2011. Demolition of structures and site restoration to a green field will be in 2013.

Over the course of the decommissioning several lessons have been learned, both good and bad. In some cases these may be called 'lessons relearned' since we were not the first to experience them, but they are important enough to bear repeating. What follows, in no particular order of importance, are some of the more exportable lessons.

LESSON #1 – CONTRACTING

At the start of the decommissioning very few NASA employees were left who had worked at the reactor when it was operating. Those that had were close to retirement and had no decommissioning experience. Rather than hire a cadre of civil servants for a one-of-a-kind project NASA's original idea was to hire one knowledgeable manager to oversee the project, and then to team with another experienced government agency that would actually perform or contract out the work.

NASA began the project under a Space Act Agreement. This is the standard interagency Memorandum of Understanding (MOU) used by NASA. In practice this is a rather generic 'gentlemen's agreement' without enforceable clauses or conditions. The other agency did have a contract with the decommissioning contractor they hired, but NASA had no such privity of contract. As a result NASA, the NRC licensee, had no ability to give direction directly to the contractor except in imminent safety situations. Management became overly complex, communication slow, document preparation and review interminable. Everyone involved was greatly frustrated. If the licensee is not self performing they must at least contract directly with the prime contractor.

When the Space Act Agreement expired it was not renewed, and NASA took the opportunity to restructure the project. This included issuing a Request for Proposal (RFP) for the remaining decommissioning work. With this structure in place NASA has had the necessary level of control.

Ironically this has reduced the number of personnel required to manage the project. Streamlined organizations make project life much easier for all layers of the organization.

LESSON #2 – ROLES AND RESPONSIBILITIES

Both the licensee and the contractor will want to be able to demonstrate they have a staff sufficient in number and experience to execute their work. Confusion about roles and responsibilities will lead to larger staffs than necessary, work being done twice (or not at all), and a lack of clarity as to who has authority. The solution is to document roles and responsibility in writing in a very clear and formal document. If the licensee is going to contract out the work then this document should be part of the RFP so the bidders know clearly what is expected of them and what the limits of their authority will be.

The actual goal is to have a competent core group of professionals who, regardless of employer, are working together for a safe and efficient project. This sounds obvious, but it is one of the toughest management challenges. If handled correctly it also has tremendous payback in project cost, schedule, and general job satisfaction.

LESSON #3 – INTERNAL COMMUNICATIONS

Work hard to establish and maintain clear and open 2-way communication channels throughout the project. Be clear on reporting requirements and keep them to a minimum. If you are not going to make specific use of some data or written report, don't collect it – doing so costs you money for no return. Worse, it distracts you (and your contractor) from the information that does matter.

When there is an incident don't be afraid to use a formal critique process to find out the facts. Remember, though, you want to determine what went wrong and how to prevent a recurrence, not who to hang. Shoot the messenger once and you'll never get the truth again.

LESSON #4 – EXTERNAL COMMUNICATIONS

Whether or not it is regulatorily required, have an aggressive, proactive community outreach effort.

Get the local media and public involved early so that you can control how the story gets out. Give them facts, explain your plans, listen to their concerns. The goal is risk communication, not public relations.

Communication must be two way – people are much more accepting of a risk if they feel they have some input into the process. This continued effort builds deposits in the ‘trust bank’, which you may need to draw on later in the project when you find a surprise that affects the public. If you wait until then to be ‘open and honest’ it’s too late, and your job will become infinitely harder.

LESSON #5 – CHARACTERIZATION

Characterize early and often. When you are done, characterize some more. While you’ll never have enough data you still need to start decommissioning some time. As equipment is removed though, and as the area dose levels drop characterization must continue. New information may even justify a change in planned approach. Plan and budget for continuing characterization until the end of the project.

An example from Plum Brook has to do with embedded pipe Derived Concentration Clean Up Levels (DCGLs). Originally there were two DCGLs, based on two different isotopic mixtures known to be in the main piping systems. As additional systems were opened, and further characterization was performed, additional isotopic mixtures were discovered. Eventually eight different DCGLs were used. This ensured cleanup efforts were correct for each section of pipe.

In another area a highly contaminated floor was shaved clean. Post remediation characterization, however, showed the existence of contamination in cracks in the surface. These cracks were not detectable until the general area dose rate had been reduced.

LESSON #6 – OFFSITE CONTAMINATION

If your plant had an offsite discharge path, even if there is no record of anything going out above limits, there is the possibility that natural processes concentrated contamination such that you now have an impacted area that requires clean up. Environmental surveys performed during operations are typically aimed at detecting a discharge at or near

the limit, with instrument whose sensitivity is appropriate for this purpose.

During Final Status Survey (FSS) you will be looking at ‘potentially impacted areas’ with much more sensitive instruments, and if there was natural concentration you may be unpleasantly surprised to find your cleanup growing. In the case of PBRF water containing Cs-137 had been discharged for years below legal release limits to an open ditch. Environmental monitoring detected no problem. Unfortunately, the sediment in the ditch contained high levels of a type of clay that latches onto cesium and doesn’t let go. Over time this clay had built up detectable levels of Cs-137, and then had worked its way 5 miles downstream through repeated erosion, deposition, and re-erosion. While the levels were eventually determined not to represent a risk to public health (average 1.5 pCi/g) it was an expensive and lengthy process to prove it.

It is recommended to perform surveys of potentially impacted offsite areas using FSS sensitivity instruments at the beginning of the decommissioning. It is much better to find any unpleasant surprises as early as possible.

LESSON #7 – SAFE STORAGE PLANTS

There are several lessons that apply specifically to plants where a significant period of time has passed between operations and decommissioning.

7A – Equipment

Maintenance of non-essential plant infrastructure is usually minimal during storage periods. The problem is that what was not essential during shutdown may be needed to support decommissioning. Examples include overhead cranes, roll up doors, HVAC, utilities, and water treatment systems. The project should plan sufficient time and budget to restore these systems from mothball to operational status.

7B – Procedures

The procedures used to operate the plant 20- 30 years ago will likely prove inadequate to today’s standards, and likely do not address many of the issues that decommissioning involves. The project should plan on the time and budget necessary to put

new procedures in place before mobilizing field workers to site. Also, be wary of anyone who says “We can take the procedures from XYZ plant and just change the cover” – it’s rarely that easy.

7C- Retirees

If the plant has been shutdown long enough there may be few, if any, personnel still working who actually were there during operations. This gap in corporate knowledge may be filled by finding and tapping into the pool of retirees in your area. Besides helping with the Historic Site Assessment (they know where the skeletons are buried) they can quickly find things in the operating day records that you might not even know existed to go look for. They can often explain why something in the plant is not the way the drawings show, since they remember when and why the change was made. Additionally, as long time local residents they have a good level of credibility with the public, and so can help with your outreach efforts.

LESSON #8 – WASTE STREAMS

Waste volumes have the ability, more than any other issue, to blow your budget apart. Insure you give a lot of thought to this for the full lifetime of your project, and always consider the impact of any trade study (Rip and Ship vs. Decontamination and FSS vs. some mix of the two) on waste stream composition, volume, and cost. Insure you have a viable disposal path for all waste before it is generated.

LESSON #9 – PLANNING THE END GAME

There is a tendency to spend a lot of time and effort planning the front end of the project, where dose rates are high and things are exciting. Then, the ‘boring and easy’ part of deconning concrete and soil and doing FSS comes along; by comparison this is often given much less forethought. The truth is that once the buildings are empty there is still a lot of work to be done. As Lesson #8 shows insufficient planning of this phase can leave you very short of budget and schedule, especially if surprises earlier in the project have already eaten your reserves. Make sure that adequate thought is given in advance to the entire project, that trade studies are not biased by the

capabilities or preferences of your prime, and that estimates for things like FSS are done by people who actually have real world experience with it.

LESSONS #10 – HAVE FUN!

Decommissioning is serious work, with real challenges and significant risks to both radiological and industrial health. It is also professionally challenging, rarely boring, constantly surprising, always educational, and a great opportunity to meet and work with a wide range of competent and dedicated professionals. Do the work, but recognize the positives in your ‘daily grind’ and have fun!

SUMMARY

1. The licensee must have privity of contract with the decommissioning contractor.
2. Formal roles and responsibilities should be established right up front.
3. Have strong and open 2-way communication within the project.
4. Have a proactive, open public outreach effort that puts deposits in the ‘trust bank’.
5. Characterize, characterize, characterize.
6. If you discharged offsite, even legally, expect to at least investigate.
7. If a plant has been in safe storage for more than a few years special efforts must be planned for and made in the areas of equipment, procedures, and retirees.
8. Decommissioning planning should focus on waste stream types, volumes, and available disposal paths and costs.
9. Don’t wait until the ‘hard part’ is done to plan the end of the project in detail – that last 10% will rapidly grow to eat your reserves.
10. It can be a great job – have fun!